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NHRI GLACIOLOGICAL ACTIVITIES 1988: ANNUAL REPORT FOR ICE, NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

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ABSTRACT

The International Glaciological Society publishes a news bulletin that reports on snow and ice research around the world. The report from the National Hydrology Research Institute deals with its work related to six of the nine categories covered - glacier studies, floating ice, remote sensing, snow, ice physics/engineering and permafrost.

RÉSUMÉ

La «International Glaciological Society» publie un bulletin de nouvelles faisant état des recherches sur la neige et la glace dans le monde. Le rapport de l'Institut national de recherches en hydrologie traite des travaux à l'institut dans six des neuf catégories traitées: études de glaciers, glaces flottantes, télédétection, neige, glace, physique/génie et pergélisol.

CATEGORY:	1 2 3 4 5 6 7 8 9	2
PROJECT TITLE:	**GLACIOLOGICAL INVESTIGATIONS OF PEYTO GLACIER, ALBERTA**	
INVESTIGATORS:	G. Holdsworth	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

The mass balance of Peyto Glacier in 1986/87 and 1987/88 were once again negative. Peyto Creek has been gauged during the winter months and the data will be used to construct the winter hydrograph. D.S. Munro (University of Toronto) continued his energy balance study. A thesis on water quality at Peyto Glacier was completed by C. Bradley under the direction of D.N. Collins (University of Manchester). Samples of preserved wood retrieved from in front of the glacier have been dated at 2900-3100 B.P. and further afield at 1140 and 505 B.P.

CATEGORY:	1 2 3 4 5 6 7 8 9	2
PROJECT TITLE:	**INVESTIGATION OF COAST MOUNTAINS' GLACIERS**	
INVESTIGATORS:	M.N. Demuth, O. Mokievsky-Zubok, A. Dalton, C. Onclin	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

An international glaciology course under the direction of Dr Gunnar Østrem, was run at the end of July on Place Glacier.

A contract for the collection of winter-, summer- and net-mass balance data on Sentinel, Helm and Place Glaciers was awarded to G.K.C. Clarke of the University of British Columbia.

For the 1987 and 1988 balance years the specific mass changes (b_a) in water equivalent (H_2O), exhibited by the three glaciers, were as follows: Sentinel Glacier +0.15 and +0.45 m; Place Glacier -0.79 and -0.97 m; and, Helm Glacier -0.85 and -0.15 m. The equilibrium line altitudes, in m a.s.l., were 1875 and 1845, 2310 and 2310, and 2030 and 2100 respectively. In collaboration with B.C. Hydro, a glacier mass-balance network was re-established on the Tiedemann and Bench Glaciers in the Homathko River basin and winter balance measurements were made in the second half of May.

CATEGORY:	1 2 3 4 5 6 7 8 9	2
PROJECT TITLE:	**PROXY CLIMATE DATA FROM ICE CORES**	
INVESTIGATORS:	G. Holdsworth, M.N. Demuth, S. Fogarasi and B. McCarthy	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

A significant positive correlation (teleconnection) has been found between the annual net mass balance time series (1900-1980) from Mount Logan, Y.T. and the areal mean of the November-March precipitation from the Steppe region of the central U.S.S.R. Teleconnections have also been found between the Mount Logan time series and series for the Canadian Prairies and Japan between 1900 and 1987. Stable isotope data indicate that "isotopic seasons" are generally phase lagged with respect to calendar seasons. They appear to be correlated with SSTs and ocean heat transfer curves as well as the position of the Aleutian Low rather than with air temperature or the temperature difference between the ocean surface and the core site. A preliminary time series analysis of 250 years of data shows spectral power at ENSO frequency at ~11 years and ~21 years.

An improved, shallow, ice-borehole logging system has been developed. It is capable of logging dry boreholes up to 200-metres deep and may be easily transported and assembled by its two operators. Modifications have been made to the Canadian Rufli-Rand core drill by incorporating an hydraulic winch/control system.

CATEGORY:	1 2 3 4 5 6 7 8 9	4
PROJECT TITLE:	**RIVER-ICE BREAK-UP ADVANCE**	
INVESTIGATORS:	T.D. Prowse	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

During melt periods, river ice can experience significant changes in strength that partly determine the severity of break-up conditions, but in situ strength tests are relatively scarce. The borehole jack is a field-portable hydraulic indentation device which enables the in situ testing of the confined-compressive strength of ice. It was used to determine changes in ice strength during an 18 day pre-break-up melt period on the Liard River, N.W.T., Canada. Measurements were also made of the river-ice energy balance. Strength, measured by ultimate platen pressure, decreased by approximately 50% at a rate of 0.4 MPa/d or 0.07-0.08 MPa/MJ $m^{-2}d^{-1}$.

Although a porosity of 0.4 is commonly assumed in the case of breakup jams, there had been no field verification of this value. On April 29, 1983, an ice jam developed at the confluence of the Liard and Mackenzie Rivers and increased to a maximum length of approximately 22.8 km by May 4. Ice jam porosity was calculated by comparing the volume of ice melted within the jam to measured changes in the total (ice and water) jam volume.

CATEGORY:	1 2 3 4 5 6 7 8 9	4
PROJECT TITLE:	**MACKENZIE DELTA HYDROLOGY**	
INVESTIGATORS:	P. Marsh and S.C. Bigras	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

The flooding regime and sill elevation of lakes in an area near Inuvik, N.W.T. was analysed using 12 to 25 years of Mackenzie River East Channel water level data. The timing of the spring rise in water levels is very consistent; peak levels occur on June 3 ±4 days. Because the magnitude of the spring flood varies greatly from year to year, only 67% of lakes in the study area flood annually in the spring. The remaining lakes have a flood frequency >1 and <4 years. By late summer water levels drop, cutting off approximately 88% of lakes from the Mackenzie River.

Break-up in the Mackenzie Delta, N.W.T. was monitored from 1981 to 1987. Thermal break-ups occurred in six of the seven years; a mechanical break-up in 1982. The location of frequent ice jams in the Delta, as well as their formation, composition, and growth, and the backwater build-up and flow diversion patterns which result have all been documented.

Water in the Delta was analysed for temperature, conductivity, pH, turbidity and ionic concentrations of calcium and magnesium. The ecology of the Delta lakes is likely quite dependent of the replenishment of minerals during the the flooding of lakes and channels in the spring.

CATEGORY:	1 2 3 4 5 6 7 8 9	5
PROJECT TITLE:	**REMOTE SENSING, DOMAIN BASIN, MANITOBA**	
INVESTIGATORS:	A. Wankiewicz	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

Ground-truth measurements of snowfall, air temperature and streamflow were obtained for six different target areas in Manitoba, Canada. Snowpack development was simulated for each target and compared with emitted microwaves. Air photos of spring flooding were obtained for the clay plain target and flooding was monitored using NOAA IR images. The microwave brightness difference between 37 and 18 GHz became increasingly negative as the snowpack increased from 2 to 200 mm H_2O when negative air temperatures only were used. If only positive air temperatures were used, the brightness difference became increasingly positive as flooded area increased.

CATEGORY:	1 2 3 4 5 6 7 8 9	6
PROJECT TITLE:	**SNOW PROPERTIES**	
INVESTIGATORS:	R.I. Perla	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

The assumption that capacitance is a linear function of snow density and liquid water was not supported in a statistical and physical calibration of a one MHz capacitive cell using 251 samples. However, a nonlinear model with high goodness-of-fit to the data was derived from physical assumptions.

Refinements to the International Snow Classification (ISC) have been proposed based on based on crystal, rather than grain, morphology. The classification was extended to include terms already in the ISC, but seldom used systematically, emphasising the distinction between and process-oriented concepts. An index of mean grain size has been described.

The snov research laboratory at Sunshine was closed in 1988. Studies in 1989 will be directed improving the interpretation of remote sensing signals from Prairie snov covers.

CATEGORY:	1 2 3 4 5 6 7 8 9	6
PROJECT TITLE:	**SNOW MANAGEMENT AND SNOWMELT INFILTRATION**	
INVESTIGATORS:	W. Nicholaichuk	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

The feasibility of stubble cropping can be improved if tall stubble strips are used for trapping snow. The average advantage in conserved soil water for tall compared to short stubble was 12.7 mm; 25% of that usually conserved by summerfallow. The economic benefit of snow trapping averaged 15-22 $/ha in dry years and 5-7 $/ha in years with average rainfall. There was no benefit in wet years. Getting the meltwater to enter the soil is still a major problem. Subsoiling to 25 cm or deeper was performed to increase infiltration. When snow management practices resulted in an appreciable snowpack, subsoiling produced over-winter soil-water gains which were two-to-four times those with conventional short stubble and no subsoiling. The field sites are located at Richlea, Kerrobert, Saskatoon and Swift Current.

CATEGORY:	1 2 3 4 5 6 7 8 9	6 and 8
PROJECT TITLE:	**SNOWMELT RUN-OFF IN PERMAFROST BASINS**	
INVESTIGATORS:	P. Marsh	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

A field study of snow-melt run-off was carried out in the Mackenzie Delta, N.W.T. and near Resolute Bay, N.W.T. The strong negative soil heat flux delayed the arrival of melt water at the snowcover base. The wetting front breaks into well-defined flow fingers which allow water to move rapidly into the snow pack without wetting the entire snow cover. If the snow is cold enough, the water will freeze making these features easy to locate. They provide an excellent method to study the natural movement of water into the dry snowcover. Field work has provided information on the freqency of flow-finger occurrence, their relationship to premelt strata, and the effect of initial snow-pack properties. Once melt water reached the snowcover base, most infiltrated the soil. Even though the soil was below 0°C, only a small portion of the melt water which infiltrated the active layer refroze. As a result, the soil warming was not as large as would be expected if all the melt water had refrozen. The large soil infiltration also limits snow-melt run-off, which has important implications to the hydrology of lakes in the Mackenzie Delta.

CATEGORY:	1 2 3 4 5 6 7 8 9	6 and 8
PROJECT TITLE:	**SNOWMELT RUN-OFF MODEL FOR NORTHERN ENVIRONMENTS**	
INVESTIGATORS:	T.D. Prowse	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

Five models have been evaluated - CEQUEAU (Institut national de recherche scientifique), SSARR (Streamflow Synthesis and Reservoir Regulation), TANK (Japanese National Disaster Prevention Center) NWSRFS (National Weather Service River Forecast System) and HSP-F (Hydrologic Simulation Program-F). In their present form it is unlikely that any will give reliable predictions of snowmelt run-off in Arctic environments without either extensive calibration of model parameters or major modifications or revisions to the simulation routines. The HYDROTEL model (Université du Québec) is also being investigated as a "base" model for the project. A field site on the Norman Wells - Zama pipeline route in the headwaters of the Petitot River is under consideration. It appears to be an ideal location because it is currently experiencing the effects of climate change and also it represents terrain which contributes low-elevation run-off to the river ice break-up/flood wave on the Liard River.

CATEGORY:	1 2 3 4 5 6 7 8 9	8
PROJECT TITLE:	**THREE-DIMENSIONAL DISTRIBUTION OF PERMAFROST**	
INVESTIGATORS:	D. Craig	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

Field work is progressing at one upland and one peat and spruce-bog site in northern Alberta. Preliminary geophysical profiles obtained in August suggest that E.M. (electro-magnetic) surveying is an excellent method for detecting permafrost at this site; providing the capability of mapping the lateral distribution of frozen ground at different times of the year.

CATEGORY:	1 2 3 4 5 6 7 8 9	8
PROJECT TITLE:	**THE THERMAL REGIME IN A PERMAFROST ENVIRONMENT**	
INVESTIGATORS:	J. Kwong	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

Two sites in northern Alberta have been selected for detailed study. The thermal regime of the Mount Watt site appears to be in equilibrium with the current climatic conditions and is very sensitive to variations in the local environment. Scattered permafrost occurrences in the Meander River site, however, could be relict.

A re-examination of occurrences of frozen ground along the Mackenzie Highway from Keg River, Alberta to Hay River, N.W.T. indicated a local northward retreat of the fringe permafrost zone by as much as 120 km in the past 25 years. To explain the disappearance of frozen ground, climatic records of the region during the past four decades were analysed. Whereas a weak warming trend is apparent from the analysis of air temperature data, a detailed explanation of the degradation of permafrost in the region has to await analyses of other contributing parameters like vegetation cover, economic development in the region, etc.

CATEGORY:	1 2 3 4 5 6 7 8 9	8 and 7
PROJECT TITLE:	**LABORATORY STUDIES OF MASS AND HEAT TRANSPORT**	
INVESTIGATORS:	J. Kwong	
INSTITUTION:	National Hydrology Research Institute	

DESCRIPTION:

Two pieces of apparatus have been designed and constructed. The soil/water freezing apparatus facilitates controlled axial freezing of a soil/water mixture. The frozen soil/water test apparatus will be used to study the effects of thermal and chemical perturbations on frozen soil.